FM Tuners: NAD and Parasound

Reviewed by Charles Hansen and Nancy and Duncan MacArthur

PHOTO 1: The NAD C 420 stereo tuner.

NAD C 420 stereo AM/FM tuner. NAD Electronics International, 633 Granite Court, Pickering, Ontario, Canada L1W 3K1, (800) 263-4641, www.NADelectronics.com. $249 U.S. Dimensions: 435mm W × 70mm H × 285mm D. Net weight: 8.8 lbs (4kg). Warranty: two years parts and labor.

Parasound TDQ-150 stereo tuner. Parasound Products, Inc., 950 Battery St., San Francisco, CA 94111, (415) 397-7100, www.parasound.com. $269 U.S. Dimensions: 9.5" W × 1.75" H × 7" D. Net weight: 4 lbs. Ten-year limited warranty.

The NAD C 420 and Parasound TDQ-150 AM/FM stereo tuners represent the budget end for high-end tuners. These two manufacturers' higher-priced tuners (NAD C 440, $349; and the full-size Parasound TDQ-1600, $400) offer better FM sensitivity and lower audio distortion specifications. However, if you don't require fringe area reception, these two tuners represent excellent values.

NAD C 420

Photo 1 shows the C 420 front panel. Just above the power switch on the left is a small green LED indicator, which turns amber in Standby mode. A row of six push buttons selects Blend, Memory, FM Mute/Mono, AM/FM, Display modes, and Preset/Tune functions. The white fluorescent display screen shows the band and frequency of the station being tuned, FM stereo, whether the station is a memory preset, and whether Blend and FM Mute are engaged. It also has a vertical seven-bar-graph signal strength indicator.

Pressing the display button cycles the display to RDS program service. Another push cycles it to RDS text. The display then returns to the default mode after a few seconds. The infrared sensor is located on the left side of the display window. A rocker switch on the right side of the unit is for the Preset/Tune functions.

The tuner chassis is black painted steel, and the cover is held on with five screws. The front bezel is plastic and the unit sits on four plastic feet with elastomer rings on the bottom. There is adequate finger space under the unit to easily lift it.

The rear panel (not shown) has the attached two-prong polarized AC line cord, a +12V trigger jack, the "NAD-Link" input and output jacks, stereo audio jacks with gold-plated shells and tin center contacts, a two-conductor AM antenna connector, and a threaded 75Ω F-type FM antenna jack.

The C 420 provides up to 30 station presets, which you can use in any combination of AM and FM stations. FM Mute and FM Blend status information is stored with each FM preset. Empty presets are skipped over during tuning to provide quicker access to the stored stations.

The preset information is stored in non-volatile EEPROM memory, which provides permanent power-off storage. Many tuners use "super capacitors" to hold the preset memory in CMOS chips for a limited time—maybe a month or so. My own NAD 4155 uses a now-tired super cap, and it must be powered up at least once a week to maintain all the presets.

FM Mute/Mode switches the C 420 to mono and disengages the muting circuitry so you can manually tune weak stations. FM Blend provides a means to automatically reduce noise and hiss on weak stations while still retaining some stereo separation. Once the signal level drops below a certain threshold, it will revert to mono. The tuning increments for FM are in

PHOTO 2: Front view of Parasound TDQ-150.

steps of 50kHz. The AM tuning steps are 10kHz (9kHz for the 230V version).

The RDS PS (Program Service) automatically displays the name of the radio station you are listening to. The RDS RT (Radio Text) button displays any additional information broadcast by the radio station, such as program format, song titles, and so on.

You can operate the C 420 with one of NAD's system remote controls via the front panel IR sensor, or through the rear panel NAD-Link jacks. You can also switch tuner AC power from amps, preamps, and AV processors that use the 12V-trigger system.

Eight pages of the 43-page manual are devoted to instructions in English. Other languages are French, German, Spanish, Italian, Portuguese, and Swedish. Programming isn't all that intuitive, so there is a two-page section on storing, recalling, and labeling presets. Ancillary items include an AM loop antenna, the usual FM dipole antenna, and a set of generic RCA audio interconnects.

PARASOUND TDQ-150

The TDQ-150 (*Photo 2*) is half the width, height, and depth of most conventional audio components. It is designed for main or remote-zone use in a custom sound system installation where space is at a premium. The unit sits on four plastic feet with foam-rubber inserts. Holes are provided on the front plate for rack mounting. The unit is very light and easy to move.

The front panel has six push buttons: On-Off, FM-AM, Preset Up/Down, and Tune Up/Down. The yellow backlit LCD display shows band and frequency, the selected station preset, and a stereo/mono indicator.

The rear panel (not shown) has an IEC power receptacle with integral fuse holder, external IR control port, +12V trigger jack, audio output jacks with gold-plated shells and tin center contacts, a two-conductor AM antenna connector, and a threaded 75Ω F-type FM antenna jack. The third pin of the AC receptacle is not connected to the chassis.

The TDQ-150 comes with a full-function remote control with separate on and off codes, "Zpre" Zone Preamplifier control, and AC line and DC triggering capabilities. To store memory presets you must use the remote. While the operation is a bit more intuitive than the NAD C 420, I still prefer the car radio method: tune the station, press the preset button for 5 seconds, voilà, you're done!

You can assign up to 30 presets to any AM or FM stations. The CMOS memory retains preset stations by means of a super-capacitor for up to 30 days without AC power. RDS program service data or text is not displayed.

FM mono is automatically engaged below 15µV RF signal level. The tuning increments for FM are the odd 200kHz U.S. spacings. The AM tuning steps are 10kHz.

TABLE 1
NAD C 420 SPECIFICATIONS AND MEASURED RESULTS

FM SECTION SPECIFICATIONS	NAD C 420	MEASURED RESULTS
Usable sensitivity, mono	2.2µV, IHF	22dBf, 3.4µV (75Ω)
Usable sensitivity, stereo	16µV, IHF	36dBf, 17µV (75Ω)
Mono quieting @ 50dB	23.3dBf, 4.0µV (75Ω)	25dBf, 5µV (75Ω)
Stereo muting/blend		37dBf
Stereo quieting @ 50dB	40.2dBf, 28µV (75Ω)	38dBf, 22µV (75Ω)
S/N, A-wtd, 65dBf, mono		71dB
S/N, A-wtd, 65dBf, stereo		69dB
Frequency response	30–15kHz, ±1.5dB	20–15kHz, +1.2, –0.5dB
THD, 1kHz mono	0.20%	0.087%
THD, 1kHz stereo	0.30%	0.29%
THD, 100–10kHz, mono		0.22%
Separation, 1kHz	>45dB	54dB
Capture ratio, 45dBf	2.4dB	
Image rejection, 400kHz	>60dB	
Auto search threshold		27dBf
Output impedance		420Ω, 1kHz
Output level		550mV, 1kHz

The ten-page manual is entirely in English. Ancillary equipment includes the remote control with batteries, power cord, FM dipole antenna, 300Ω-to-75Ω balun, and AM loop antenna with self-adhesive bracket.

INSIDE THE NAD C 420

Photo 3 shows the NAD C 420 with the cover removed. The power transformer occupies the left rear of the chassis, and connects to the switch/LED board in the left front. The display/control PC board sits behind the front panel. Occupying most of the right side of the chassis is the large single-sided phenolic tuner board. A schematic was not furnished with the unit.

The display board connects to the tuner board through three ribbon cables, and the power transformer secondary connects via

PHOTO 3: Interior view of NAD C 420.

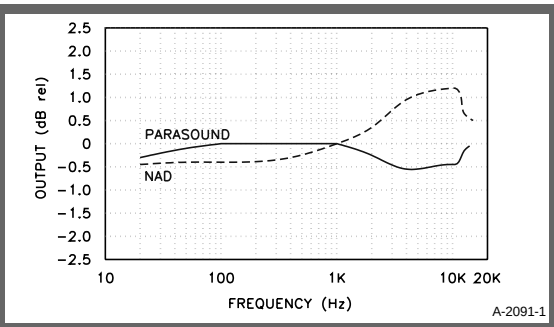


FIGURE 1: Frequency response—FM tuners.

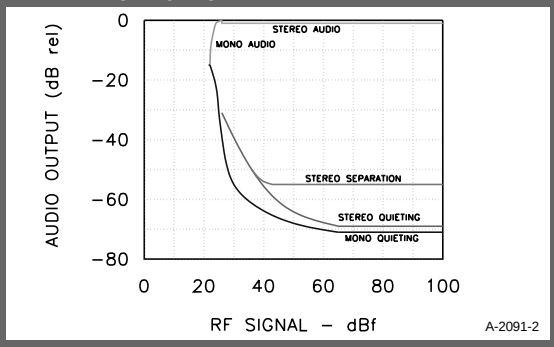


FIGURE 2: FM quieting—NAD C 420.

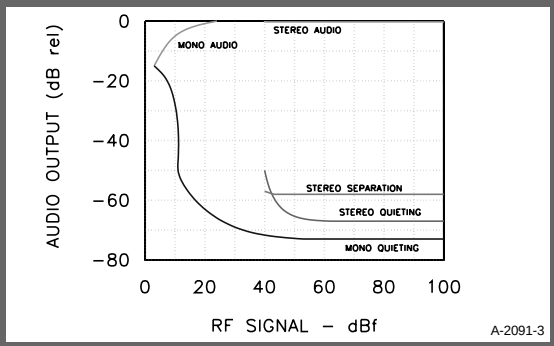


FIGURE 3: FM quieting—Parasound TDQ-150.

CRITIQUE—NAD C 420, PARASOUND TDQ-150, AND ADCOM GFT-555II

By Nancy and Duncan MacArthur

Some years ago we moved toward a minimalist audio system: one source, one volume control, one amplifier, and one set of speakers. In the process we eliminated much equipment, including our old Dynaco FM-5 tuner.

In the intervening years we forgot how much fun playing with a tuner could be. After burning in the NAD C 420, the Parasound TDQ-150, and the ADCOM GFT-555II, we spent hours flipping through the FM band, finding a huge variety of music—some pieces familiar, some not. We ran across Navajo chants, opera, rock, symphonies, and Spanish music, not to mention the local deejay who termed himself the "Commissar of Your Radio Commune."

Eventually the situation got out of hand. When the public radio station ran a long program of Colombian music, I found myself dancing around the living room to the Swamp Cumbia. Halfway through the song, I turned and ran smack into a scandalized eleven-year-old.

"Cut it out, Mom," he growled.

"Whatever for?" I asked.

He considered the matter briefly. "'Cause if you don't, I'm gonna get out the video camera and put you on the Internet."

Oh. Perhaps it was time to stop dancing and start writing this review.

REVIEWING TUNERS

An FM tuner review requires a different listening approach from reviews of other components. Local FM stations rarely provide a clean, uncompressed signal. Even if their signal quality is good, they typically don't play the same piece repeatedly for the convenience of reviewers. Obviously, under these circumstances a listening critique of tuners can't be as rigorous as critiques of other components. But at least three aspects of tuner performance beyond lab test results have some importance.

First, listening tests may reveal some sonic differences. If the tuners all sound the same, we'll say so; when we hear obvious differences, we'll point them out. Second, if the sonic signatures are similar, the choice may devolve upon price, features, and operational convenience. Third, a brief comparison between these tuners and other sources may be useful. Our goal is to give you an idea of what to expect before making a purchase.

The NAD C 420 and the Parasound TDQ-150 arrived from the manufacturers by way of Chuck Hansen's lab. The ADCOM GFT-555II was an older model borrowed from Ed Dell for use as a baseline.

We burned in each tuner with an antenna signal sufficient to exceed its muting threshold for at least 100 hours. Tuners are significantly easier to burn in than many other components because they do not have moving parts or large sources of heat. The sound of the NAD and Parasound changed significantly over the burn-in period. (Presumably the ADCOM had burned in long ago.)

Following burn-in, we listened to each tuner in turns using the same set of popular and classical stations. As might be anticipated, the popular stations provided a horribly compressed signal. (On the other hand, they frequently played songs we knew well.) The rest of the reproduction system was identical in each case, and all three tuners were plugged into the same circuit of a Monster Cable HTS 2000 power conditioner.

Each tuner also receives the AM band, although we concentrated on FM performance in this review.

ANTENNAS

The reception quality of any tuner critically depends on the antenna connected to it. For all our serious listening we used a multi-element roof-mounted Radio Shack special.

Out of curiosity we briefly connected the twin lead dipoles supplied in each box to their respective tuners. Because most of the stations we listen to are about a hundred miles away, we didn't anticipate satisfactory performance from the dipoles. *Table 1* lists the number of stations in our area that each tuner received cleanly. When we say *cleanly*, we mean with lack of noise and sibilant distortion. (Many more stations were intelligible from a DXer's standpoint.)

Practically speaking, all these sensitivities were comparable except for the NAD's reception with the indoor dipole. All three tuners exhibited good sensitivity when attached to a "real" antenna.

Even if your system hasn't suffered from them before, the introduction of an external antenna that is grounded for safety reasons often causes a ground loop. The antenna safety ground is likely to be located far from the audio system ground and may easily be at a different potential. These problems may be exacerbated by a grounded tuner (such as the Parasound) but can be present even if the tuner itself is ungrounded. Numerous companies, including Jensen, Mondial, Tributaries, and MIT, manufacture products intended to break these ground loops.

APPEARANCE

The NAD C 420 is a rarity among components: a good-looking black box, well proportioned with an elegant oval display window. Its preset/tune rocker echoes the shape of its display window. The most salient feature of the Parasound's appearance is its tiny size—roughly half as wide, half as high, half as deep as the other tuners. (If you have a 17″ rack, you could mount the Parasound side-by-side with its matching preamplifier.) The ADCOM GFT-555II is a standard chunky black box; its most noticeable feature is a long row of buttons on the front panel.

Popping open the Parasound reveals a single, densely packed, PC board. The board dominates the interior of the Parasound and fills the available space. Although the Parasound is much smaller than the other tuners, it weighs about the same.

The NAD's main PC board is well laid out and less densely packed. It fills about half the enclosure. As you might expect in an older component, the ADCOM's main board nearly fills its box. Although all three tuners are well laid out and cleanly constructed, the NAD and ADCOM probably would be easier to service or modify due to the extra "elbow room" within the enclosure.

EASE OF USE

Both the Parasound TDQ-150 and the ADCOM GFT-555II were easy to use. The Parasound has five front-panel buttons and includes a remote. To set the presets you must use the remote. (You can tune the presets sequentially using buttons on the front panel). The remote is also handy for changing stations and accessing the presets in random order; in addition, it has preamplifier controls intended for use with a matching preamplifier (also half rack width). The Parasound uses the U.S. frequency interval of 0.2MHz and can be tuned rapidly across the FM band.

The 30 presets on this tuner are accessible in sequence by the up-and-down buttons on the front panel. We preferred the random access ability provided by the remote. The tuning buttons on the Parasound operate in two modes. A short press on one of the tuning buttons will change the frequency by 0.2MHz. According to the manual a continuous press will tune to the next strong station; however, our sample would not stop at any station regardless of strength. Like the Energizer Bunny®, it kept going and going and going.

The ADCOM GFT-555II has only 16 presets (8 AM and 8 FM) but has an individual front-panel button permanently assigned to each. It thus provides totally random access for setting and tuning the preset frequencies. The ADCOM didn't come with a remote, and its manual makes no mention of remote capability. It tunes in 0.1MHz intervals.

The ADCOM has three modes of tuning. A short press on one of the tuning buttons will change the frequency by 0.1MHz, and a continuous press will tune continuously. Activating the "FM scan" switch will stop the tuning at the next strong station. These features are straightforward and easily understood; describing them here takes more time than learning to use them.

The NAD C 420 also features 30 presets that are accessible sequentially from the front panel. A remote control is optional with the NAD: it's the same remote supplied with the matching NAD preamp, and the manufacturer doesn't want to charge you twice. If you buy the tuner but not the preamp, we would strongly recommend purchasing the remote separately.

Many of the NAD's features were not self-explanatory: we frequently had to refer to the manual. The technique for erasing presets, which required multiple timed pushes of two buttons, seemed particularly opaque.

Different buttons operated in different ways. Some toggled front-panel lights, and some didn't. We had to push some for a certain number of seconds to enable one feature and a different number of seconds to enable another.

The NAD uses a seek mode of tuning: it stops at every strong station whether you want it to or not. This characteristic becomes less important once the presets are set but can lengthen the process of moving from one end of the band to the other.

This tuner also incorporates RDS, a useful feature *if* nearby stations transmit RDS information and *if* the

TABLE 1
NUMBER OF STATIONS RECEIVED CLEANLY FOR EACH TUNER/ANTENNA COMBINATION.

	OUTDOOR ANTENNA	INDOOR DIPOLE
NAD C 420	25	19
Parasound TDQ-150	29	26
ADCOM GFT-555II	27	25

TABLE 2

PARASOUND TDQ-150 SPECIFICATIONS AND MEASURED RESULTS

FM SECTION SPECIFICATIONS	PARASOUND TDQ-150	MEASURED RESULTS
Usable sensitivity, mono		10dBf
Mono quieting @ 50dB	11.0dBf, 1μV (75Ω)	11dBf, 1μV (75Ω)
Stereo muting (Fixed)		40dBf
Stereo quieting @ 50dB	37.2dBf, 20μV (75Ω)	40dBf, 27μV (75Ω)
S/N, A-wtd, 65dBf, mono		74dB
S/N, A-wtd, 65dBf, stereo	>74dB	68dB
Frequency response	30–15kHz, ±1dB	20–15kHz, +0, –0.5dB
THD, 1kHz mono	0.08%	0.09%
THD, 1kHz stereo	0.20%	0.15%
THD, 100–10kHz, mono		0.28%
Separation, 1kHz	50dB	58dB
Separation, 100–10kHz	40dB	
Alt. ch. selectivity, 400kHz	80dB	
Capture ratio, 45dBf	<1.5dB	
AM suppression	60dB	
Auto search threshold		20dBf
Output impedance		600Ω, 1kHz
Output level		580mV, 1kHz

eight individual wires. The shielded MOSFET RF front end sits just behind the two antenna connectors. A Sanyo LA7218 and LA1837 chip set handles PLL frequency synthesis and AM/FM tuning and RDS decoding operations. The EEPROM preset storage memory chip is under the wide ribbon cable.

The FM tuner appears to have a three-stage IF (intermediate frequency) section. A pair of emitter-follower audio transistors feed the audio jacks.

INSIDE THE TDQ-150

Photo 4 shows the interior of the TDQ-150 tuner. The power transformer sits on the left side of the chassis, with the display/control PC board behind the front panel. The compact double-sided epoxy tuner board occupies most of the chassis. A schematic was not furnished with the unit.

The display board connects to the tuner board through three Molex-style connectors, and the right side wiring loops through a toroidal ferrite core. The transformer secondary is hard-wired to the PC board, where a pair of fuses deliver low-voltage AC to the power supply. The power transformer primary remains energized when the tuner is plugged in. The front panel On-Off switch operates a power-supply relay that switches the low-voltage secondary. Linear regulators provide +5V DC and ±12V DC to the circuitry.

The shielded MOSFET RF front end sits just behind the AM antenna connector. A Sanyo LA3401 and LA1266 chip set handles PLL frequency synthesis and AM/FM tuning operations.

The FM tuner appears to have a two-stage IF section, with ground braid straps connecting the IF transformer cases to the RF front-end shield. Parasound describes it as an ultra-wideband IF section for low distortion, flat response, and a wide dynamic range. Several audio transistors are located near the output jacks, so the TDQ-150 also appears to have a discrete audio output stage.

MEASUREMENTS—NAD FM SECTION

I did not run any tests on the AM sections of either tuner, except to make sure they were functional.

The C 420 does not invert polarity. The output impedance at 1kHz was 420Ω, delivering 550mV into a load of 100k.

The frequency response (*Fig. 1*) was within +1.2, –0.5dB from 20Hz to 15kHz. The response curve above 10kHz may not be entirely accurate. In this area there are three filter responses: the 75μs pre-emphasis and steep 16kHz LP filter on the audio that is fed to the FM signal generator, and the 75μs de-emphasis in the tuner under test. Audio crosstalk perfor-

signals are changing—in a car, for example. Neither possibility holds true in a fixed installation in the U.S. (Only one station in our area broadcasts an RDS signal.) Clearly the NAD is intended for European markets as well as the U.S. The C 420 has RDS capability and a multilingual manual, and it tunes in 0.05MHz increments, requiring four steps between U.S. stations.

SOUND JUDGMENTS

Given an adequate antenna, all three tuners produced a completely acceptable sound. One small exception: all three grated on us occasionally during operatic soprano solos, but we ascribed this effect to the listeners' taste rather than to the tuners. None of the tuners bested our reference SACD player (Sony SCD C333ES) sonically, a not-unexpected result.

Although all three tuners sounded pleasant, each had a distinct sonic signature. The sound of the NAD could best be characterized as inoffensive: most defects in reproduction were subtractive rather than additive. The midbass response of the NAD was slightly loose or boomy; this effect was especially apparent on rock recordings. The NAD's response seemed a bit recessed at both frequency extremes, but this effect was small and may have been due to the source material.

The NAD presented a good soundstage, extending from speaker to speaker, but the images within this stage were not particularly well defined. The NAD's sound seemed slightly compressed, even more compressed than the source material. This effect was especially noticeable when we listened to classical music stations, which tend to transmit less compressed signals.

The Parasound produced a precise, detailed sound. I characterized it as having detail and clarity, while Duncan saw it as having a slight high-frequency emphasis. In any event, the high-frequency response was clean, extended, and never fatiguing.

The Parasound's imaging was sharp and well-defined. Its soundstage was similar to the NAD's; however, the detail and clarity of the Parasound extended to the spatial characteristics as well. With well-recorded material the images of individual instruments were well separated and sized appropriately. The Parasound seemed capable of reproducing as much dynamic information as was transmitted.

In comparison, the ADCOM presented a smooth, natural sound. No frequency region was missing or particularly emphasized. The soundstage was very wide, occasionally extending beyond the speakers. The ADCOM's imaging was somewhat smeared: each instrument appeared to originate from a space several feet across rather than a single location.

The dynamics produced by the ADCOM were good without being obtrusive. Again, with this tuner we had the impression that the dynamic range was limited more by the transmitted signal than by the tuner.

FINAL THOUGHTS

NM: All three tuners had a pleasant sound; none produced fatigue even after hours of listening. To choose among them, focus on which specific characteristics mean most to you. If looks are your top priority, buy the NAD. If you plan to make extensive modifications, pick the NAD or the ADCOM—you'll have more working room. If you want a spare, precise sound with good imaging and good dynamics, go for the Parasound. If you prefer a fuller sound, again with good dynamics, look for the ADCOM on the used-equipment market.

DM: As with most decisions, the choice of "best" tuner in this group depends on which features are most important to the buyer. Both the NAD and the Parasound are currently available; you would need to purchase a used ADCOM. Both newer tuners have automation features (remote control, DC switching, and so on) that are not available on the ADCOM. The ADCOM was designed as a stand-alone stereo tuner, while both the NAD and the Parasound seemed intended to be part of a home theater system.

Both the NAD and the Parasound are visually interesting, although in different ways. I like the small size of the Parasound, but this same size would make it less appropriate in a stack of 17″ components (unless you pair it with Parasound's matching preamp, amplifier, or phono preamp.) The ADCOM is supremely easy to use but lacks some features in comparison with its remote-controlled brethren. (If you purchase the NAD, I strongly recommend buying the optional remote control—use of the presets, in particular, is arcane when using the front-panel controls.)

Sonically each tuner offers a different picture. Depending on the program material, I alternately preferred the sound of either the Parasound or the ADCOM. The Parasound possesses good imaging and a very detailed sound. It works well in a tube-based system, such as ours, which has a smooth high-frequency response and no need of additional bass emphasis.

The ADCOM is fuller and arguably more natural but lacks some detail when compared to the Parasound. Although the NAD didn't match well with our system, it might be better matched to a solid-state system that could use a bit more bloom in the lower midrange.

mance was 54dB at 1kHz.

THD+N at 1kHz was 0.087% mono, and 0.29% stereo. During distortion testing, I engaged the test set 80kHz low-pass filter to limit the out-of-band noise. THD from 100–10kHz, mono, did not exceed 0.22%.

The mono audio distortion residual waveform shows mainly the second harmonic, overlaid with noise.

The C 420 tuner quieting characteristics are shown in *Fig. 2*. I had to switch to FM/Mute mode to measure mono sensitivity. The station auto search threshold, where it would stop at the signal generator's frequency during a station scan, was 27dBf. There was no overload at the maximum RF input of 100dBf. The audio output disappeared when I moved the FM test signal ±50kHz to either side of the tuned center frequency. Stereo audio output was –0.9dB below the mono audio at 65dBf signal strength.

The seven bars of the display's tuning strength meter change at the RF signal levels are:

Bar 1 (always on)
Bar 2 at 25dBf
Bar 3 at 30dBf
Bar 4 at 33dBf
Bar 5 at 36dBf
Bar 6 at 39dBf
Bar 7 at 41dBf

PHOTO 4: Interior view of Parasound TDQ-150.

MEASUREMENTS—PARASOUND FM SECTION

Again, I did not run any tests on the AM section, except to verify its operation. The TDQ-150 inverted polarity; the tuner's audio output being out of phase with the composite audio signal fed to the FM signal generator's varactor modulator. The output impedance at 1kHz was 600Ω, delivering 580mV into a load of 100k.

The TDQ-150 tuner frequency response (*Fig. 1*) was within +0, –0.5dB from 20Hz to 15kHz. Crosstalk performance at 1kHz measured 58dB.

THD+N at 1kHz was 0.09% mono, and 0.15% stereo. THD from 100–10kHz, mono, did not exceed 0.28%.

The mono audio distortion residual waveform again showed mainly the second harmonic, overlaid with noise.

The TDQ-150 quieting characteristics are shown in *Fig. 3*. The station auto search threshold was 20dBf. There is no method for manually switching the FM/Mute mode, and the tuner switches back to mono at a high 40dBf, right where the –50dB stereo quieting occurs.

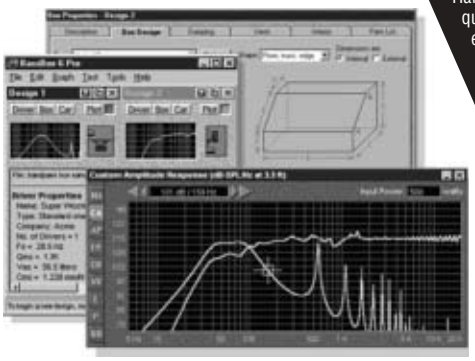
The audio output didn't disappear until I moved the FM test signal ±150kHz to either side of the tuned center frequency, probably reflecting the reduced sensitivity of the two-stage IF design. This is not an issue with the U.S. 200kHz FM radio station spacings. There was no overload at the maximum RF input of 100dBf. Stereo audio output was only –0.3dB below the mono audio at 65dBf signal strength. ❖

Design speaker boxes with BassBox Pro

Need help with your speaker designs? BassBox Pro & X•over Pro can help!

Design crossovers with X•over Pro

Design speaker boxes for any space: car, truck, van, home hi-fi, home theater, pro sound, studio, stage, PA and musical instruments. Import acoustic measurements. For example, the response of a car can be imported to simulate the in-car response.



$129 plus S&H

HARRISTECH

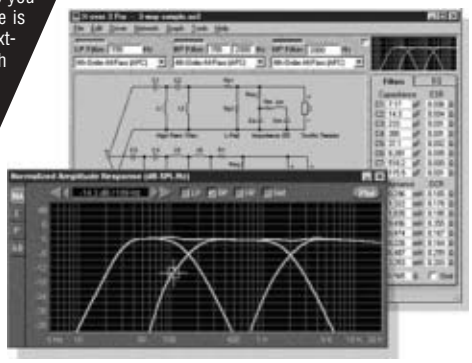
Harris Tech *Pro* software for Microsoft® Windows can help you quickly create professional speaker designs. Our software is easy to use with features like "Welcome" windows, context-sensitive "balloon" help, extensive online manuals with tutorials and beautifully illustrated printed manuals. We include the *world's largest driver database* with the parameters for many thousands of drivers.

For more information please visit our internet website at:
www.ht–audio.com

Tel: 616-641-5924
Fax: 616-641-5738
sales@ht–audio.com

Harris Technologies, Inc.
P.O. Box 622
Edwardsburg, MI
49112-0622
U.S.A.

Design 2-way and 3-way passive crossover networks, high-pass, band-pass or low-pass filters, impedance equalization, L-pads and series or parallel notch filters. Its Thiele-Small model provides professional results without complex testing.



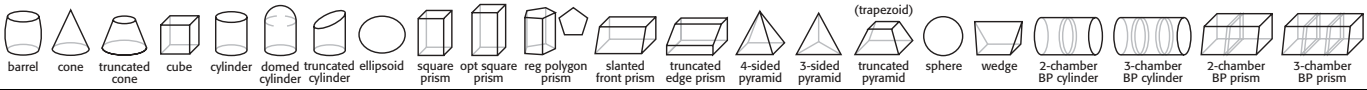
$99 plus S&H

Sophisticated Driver Modeling and Advanced Box Design

• Multiple drivers with isobaric, push-pull and bessel options. • 3 dual voice coil wiring options. • "Expert Mode" dynamically analyzes driver parameters. • Design closed, vented, bandpass and passive radiator boxes. • "Suggest" feature provides fast box design. • All box types account for leakage losses and internal absorption. • Advanced vent calculation. • Bandpass boxes can be single or double-tuned with 2 or 3 chambers. • 22 box shapes (shown below). • Open up to 10 designs at one time. • Analyze small-signal performance with: Normalized Amplitude Response, Impedance, Phase and Group Delay graphs. • Analyze large-signal performance with: Custom Amplitude Response, Max Acoustic Power, Max Electric Input Power, Cone Displacement and Vent Air Velocity graphs. • Includes a helpful "Design Wizard" for beginners.

Passive Crossover Filters and Scalable Driver Modeling

• 1st, 2nd, 3rd and 4th-order "ladder" filter topologies. • Parallel crossover topology. • 2-way crossovers offer Bessel, Butterworth, Chebychev, Gaussian, Legendre, Linear-Phase and Linkwitz-Riley filters. • 3-way crossovers offer All-Pass Crossover (APC) and Constant-Power Crossover (CPC) filters. X•over Pro's capabilities scale to fit the amount of driver data. • A crossover, filter or L-pad can be designed with just the nominal impedance of each driver. • With full Thiele-Small parameters, impedance equalization can be designed and the performance graphed. • Graphs include: Normalized Amplitude Response, Impedance, Phase & Group Delay. • Graphs can include the full speaker response including the box. • Estimate component resistance (ESR & DCR). • Calculate the resistance of parallel or series components.



Copyright © 2002 by Harris Technologies, Inc. All rights reserved worldwide. BassBox is a trademark of Harris Tech. Other trademarks belong to their respective companies. Harris Tech reserves the right to make changes without notice. All prices are in U.S. dollars.